What is claimed is:

1. A scanning probe microscope assembly for examining an object, comprising:

a probe having a tip with a sharp end;

means for inducing and detecting non-optical interaction of said tip and said object;

a light source optically coupled to said tip for providing light to said tip;

said tip being shaped to emit said provided light at said sharp end so that said emitted light optically interacts with said object; and

a photodetector for detecting light resulting from said emitted light optically interacting with said object.

2. A scanning probe microscope assembly as recited in claim 1 wherein:

said probe includes a cantilever connected to said tip; and

said non-optical interaction inducing and detecting means includes means for inducing atomic force interaction between said tip and said object and for detecting deflection of said cantilever due to said atomic force interaction.

3. A scanning probe microscope assembly as recited in claim 1 wherein said non-optical interaction inducing and detecting means includes means for inducing and detecting a tunneling current between said tip and said object.

4. A scanning probe microscope assembly as recited in claim 1 further comprising a spectrophotometer including said light source and said photodetector for making spectrophotometric measurements of said resulting light.

5. A scanning probe microscope assembly as recited in claim 1 wherein:

said tip has a base; and

said scanning probe microscope assembly further comprises a lens disposed over said tip and optically coupled between said light source and said tip for focusing said provided light in said base of said tip.

6. A scanning probe microscope assembly as recited in claim 5 wherein said lens is a fresnel lens.

7. A scanning probe microscope assembly as recited in claim 6 wherein said fresnel lens is formed in said probe over said tip.

8. A scanning probe microscope assembly as recited in claim 5 wherein said lens is a refractive lens.

9. A scanning probe microscope assembly as recited in claim 1 wherein:

said tip is shaped to capture said resulting light; and

said photodetector is optically coupled to said tip for detecting said captured light.

10. A scanning probe microscope assembly as recited in claim 9 wherein:

said tip has a base; and

said scanning probe microscope assembly further comprises a lens disposed over said tip and optically coupled between said light source and said tip for focusing said provided light in said base of said tip, said lens also optically coupled between said tip and said photodetector for focusing said captured light for detection by said photodetector.

11. A scanning probe microscope assembly as recited in claim 10 further comprising means for directing said provided light to said lens and for directing said focused captured light to said photodetector.

12. A scanning probe microscope assembly as recited in claim 11 wherein said directing means includes a fiber optic light guide optically coupled between said light source and said lens and between said photodetector and said lens.

13. A scanning probe microscope assembly as recited in claim 1 wherein said tip includes a core material transparent to said provided light and an

obdurate layer transparent to said provided light over said core material at least at said sharp end.

14. A scanning probe microscope assembly as recited in claim 13 wherein said obdurate layer comprises diamond oriented normal to the surface of said core material.

15. A scanning probe microscope assembly as recited in claim 13 wherein said obdurate layer comprises silicon carbide.

16. A scanning probe microscope assembly as recited in claim 15 wherein said silicon carbide is doped to be conductive.

17. A scanning probe microscope assembly as recited in claim 13 wherein said obdurate layer comprises carbon nitride.

18. A scanning probe microscope assembly as recited in claim 13 wherein said obdurate layer comprises tungsten.

19. A scanning probe microscope assembly as recited in claim 1 wherein said tip includes a core material transparent to said provided light and a light emissive coating over said core material at said sharp end.

20. A scanning probe microscope assembly as recited in claim 1 wherein said tip includes a core material transparent to said provided light and a frequency doubling coating over said core material at said sharp end.

21. A scanning probe microscope assembly as recited in claim 9 wherein said photodetector includes a photodiode formed in said tip for detecting said captured light.

22. A scanning probe microscope assembly as recited in claim 21 wherein:

said photodiode comprises:

a first doped silicon region in said tip;

a second doped silicon region in said tip oppositely doped to and in contact with said first doped region;

a first conductive region in contact with said first doped region;

a second conductive region in contact with said second doped region;

said photodetector further comprises a photodiode measurement circuit coupled across said first and second conductive regions for making measurements of said captured light detected by said photodiode.

23. A scanning probe microscope assembly for examining an object, comprising:

a probe having a tip, said tip including:

a core material with a sharp end;

a light emissive layer over at least a portion of said core material; and

a conductive layer over said light emissive layer but not over said core material at said sharp end;

means for applying a voltage between said conductive layer and said core material so that said light emissive layer emits light within said probe that propagates through said probe and is emitted at said sharp end, said emitted light optically interacting with said object;

a photodetector for detecting light resulting from said emitted light optically interacting with said object;

24. A scanning probe microscope assembly as recited in claim 23 wherein:

said probe includes a cantilever connected to said tip; and

said scanning probe microscope assembly further comprises means for inducing atomic force interaction between said tip and said object and for detecting deflection of said cantilever due to said atomic force interaction.

25. A scanning probe microscope assembly as recited in claim 23 further comprising means for inducing and detecting a tunneling current between said tip and said object.

26. A scanning probe microscope assembly as recited in claim 23 wherein said emissive layer comprises gallium nitride.

27. A scanning probe microscope assembly as recited in claim 23 wherein said emissive layer comprises gallium arsenide.

28. A scanning probe microscope assembly as recited in claim 23 wherein said emissive layer comprises silicon carbide doped to be emissive.

29. A scanning probe microscope assembly for examining an object, said scanning probe microscope assembly having a tunneling current mode and an atomic force mode, said scanning probe microscope comprising:

a probe having a base, a cantilever connected to said base, and a tip connected to said cantilever;

tunneling current means for inducing and detecting a tunneling current between said tip and said object during said tunneling current mode; and

atomic force means for inducing atomic force interaction between said tip and said object and for detecting deflection of said cantilever due to said atomic force interaction during said atomic force mode;

holding means for holding said cantilever rigid with respect to said base during said tunneling current mode.

30. A scanning probe microscope assembly as recited in claim 1 wherein said holding means includes:

a clamping structure connected to said base; and

clamping control means for controlling said clamping structure to hold said cantilever rigid with respect to said base during said tunneling current mode.

31. A scanning probe microscope assembly as recited in claim 30 wherein:

said cantilever has a free end adjacent to said tip;

said clamping structure is a clamping arm extending from said base and having a free end extending past and opposing said free end of said cantilever; and

said clamping control means including means for controlling movement of said free end of said clamping arm against said free end of said cantilever during said tunneling mode to hold said cantilever rigid with respect to said base.

32. A scanning probe microscope assembly as recited in claim 30 wherein:

said clamping structure surrounds said cantilever and includes clamping arms; and

said clamping control means including means for controlling movement of said clamping arms against said cantilever during said tunneling mode to hold said cantilever rigid with respect to said base.

33. A scanning probe microscope assembly as recited in claim 30 wherein:

said cantilever has a lower surface to which said tip is connected and an upper surface;

said holding means includes:

a member having a lower surface disposed over said upper surface of said cantilever;

an insulating layer between said upper surface of said cantilever and said lower surface of said member;

means for applying a voltage between said member and said cantilever to electrostatically hold said cantilever rigid with respect to said base during said tunneling current mode.

34. A scanning probe microscope assembly as recited in claim 30 wherein said insulating layer is disposed on said lower surface of said member.

35. A scanning probe microscope assembly as recited in claim 30 wherein said insulating layer is disposed on said upper surface of said cantilever.

36. A scanning probe microscope assembly as recited in claim 30 wherein said cantilever has a lower surface to which said tip is connected and an upper surface;

said holding means includes:

a member disposed over said upper surface of said cantilever;

a first coil on said upper surface of said cantilever;

a second coil on said lower surface of said element;

means for producing currents in said coils to magnetically hold said cantilever rigid with respect to said base during said tunneling current mode.

37. A scanning probe microscope assembly as recited in claim 30 wherein said cantilever has a lower surface to which said tip is connected and an upper surface;

said holding means includes:

a member disposed over said upper surface of said cantilever;

a permanent magnet on said upper surface of said cantilever;

a coil on said lower surface of said element;

means for producing a current in said coil to magnetically hold said cantilever rigid with respect to said base during said tunneling current mode.

38. A scanning probe microscope assembly as recited in claim 30 wherein said cantilever has a lower surface to which said tip is connected and an upper surface;

said holding means includes:

an element coupled to said base having a lower surface disposed over said upper surface of said cantilever;

a permanent magnet on said lower surface of said element;

a coil on said upper surface of said cantilever;

means for producing a current in said coil to magnetically hold said cantilever rigid with respect to said base during said tunneling current mode.

39. A scanning probe microscope assembly as recited in claim 29 wherein said scanning probe microscope assembly also has a spectrophotometry mode and further comprises:

a spectrophotometer including a light source optically coupled to said tip;

light source control means for controlling said light source to provide light to said tip during said spectrophotometry mode;

said tip being shaped to emit said provided light at said sharp end so that said emitted light optically interacts with said object;

said spectrophotometer including a photodetector for detecting light that results from said emitted light optically interacting with said object to make spectrophotometric measurements of said detected light.

40. A scanning probe microscope assembly as recited in claim 39 wherein said scanning probe microscope assembly also has a near-field optical mode and further comprises:

rotationally polarizing means for rotationally polarizing said provided light;

said light source control means including means for controlling said light source to provide light to said tip during said near-field optical mode and for controlling said rotationally polarizing means to rotationally polarize said provided light during said near-field optical mode;

deep surface feature analysis means coupled to said photodetector for identifying deep surface features based on said resulting light detected by said photodetector during said near-field optical mode.

41. A scanning probe microscope assembly as recited in claim 40 wherein said scanning probe microscope assembly also has a hardness testing mode and further comprises:

directing means for directing said tip to penetrate said object at a specific point with a predefined known force;

said light source control means includes means for controlling said light source to provide light to said tip during said hardness testing mode before and after said tip penetrates said object;

said tip emitting at said sharp end said light provided before and while said tip penetrates said object so that said emitted light optically interacts with said object before and while said tip penetrates said object;

said photodetector detecting light resulting from said emitted light optically interacting with said object before and while said tip penetrates said object; and

comparing means for comparing said resulting light detected before said tip penetrates said object with said resulting light detected while said tip penetrates said object to determine the hardness of said object.

42. A scanning probe microscope assembly as recited in claim 40 wherein said scanning probe microscope assembly also has a hardness testing mode and further comprises:

means for directing said tip to penetrate said object at a specific point with a predefined known force;

means for measuring the conductivity of said object before and while said tip penetrates said object to determine the hardness of said object.

43. A scanning microscope probe comprising:

a cantilever; and

a tip fixed to said cantilever including a tip shaped core material with a sharp end and an obdurate layer over said tip shaped core material at least at said sharp end.

44. A scanning probe microscope assembly as recited in claim 43 wherein said obdurate layer comprises diamond oriented normal to the surface of said core material.

45. A scanning probe microscope assembly as recited in claim 43 wherein said obdurate layer comprises silicon carbide.

46. A scanning probe microscope assembly as recited in claim 45 wherein said silicon carbide is doped to be conductive.

47. A scanning probe microscope assembly as recited in claim 43 wherein said obdurate layer comprises carbon nitride.

48. A scanning probe microscope assembly as recited in claim 13 wherein said obdurate layer comprises tungsten.

49. A scanning microscope probe with a photodiode tip comprising:

a tip shaped silicon material with a sharp end;

a first doped silicon region in said tip;

a second doped silicon region in said tip oppositely doped to and in contact with said first doped region;

a first conductive region in contact with said first doped region;

a second conductive region in contact with said second doped region.

50. A scanning microscope probe comprising:

a tip shaped core material with a sharp end;

a light emissive layer over at least a portion of said core material; and

a conductive layer over said light emissive layer but not over said core material at said sharp end.

51. A scanning probe microscope assembly as recited in claim 50 wherein said emissive layer comprises gallium nitride.

52. A scanning probe microscope assembly as recited in claim 50 wherein said emissive layer comprises gallium arsenide.

53. A scanning probe microscope assembly as recited in claim 50 wherein said emissive layer comprises silicon carbide doped to be emissive.

54. A microscope system comprising:

a microscope assembly to microscopically scan an object and generate data representing a microscopic image of at least a portion of the object;

a display responsive to the generated data to display the microscopic image; and

a color mapping tool for mapping specific ranges of colors to specific ranges of heights of data points of the microscopic image.